

#12

SEQUENCE LISTING

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The Government of the United States of America
as represented by the Secretary of the
Department of Health and Human Services

<120> Vaccines for Blocking Transmission of Plasmodium vivax

<130> 015280-34210US

<140> US 09/554,960
<141> 2003-02-12

<150> US 60/045,283
<151> 1997-05-01

<150> WO PCT/US98/25742
<151> 1998-12-04

<160> 24

<170> PatentIn Ver. 2.0

<210> 1
<211> 1066
<212> DNA
<213> Plasmodium vivax

<220>
<221> CDS
<222> (147)..(857)
<223> Pvs28

<400> 1
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ttatacaaaa acgactcccc ctttgagata acacccaact gagctcgatt cccctcccc 120
actttttgcgc ctcccccttg ttcaaa atg aat acc tac cac agc ttg ctg ttc 173
Met Asn Thr Tyr His Ser Leu Leu Phe
1 5
ctt ctg gcc atc gtg ctt act gtt aag cac acc ttc gca aag gtc acc 221
Leu Leu Ala Ile Val Leu Thr Val Lys His Thr Phe Ala Lys Val Thr
10 15 20 25
gcg gag acc caa tgc aaa aat ggc tat gta gtc caa atg agc aat cat 269
Ala Glu Thr Gln Cys Lys Asn Gly Tyr Val Val Gln Met Ser Asn His
30 35 40
ttt gaa tgc aaa tgc aac gac ggg ttt gtt atg gca aat gaa aac act 317
Phe Glu Cys Lys Cys Asn Asp Gly Phe Val Met Ala Asn Glu Asn Thr
45 50 55
tgc gag gaa aaa cgc gat tgc aca aat cca caa aat gta aat aaa aac 365
Cys Glu Glu Lys Arg Asp Cys Thr Asn Pro Gln Asn Val Asn Lys Asn
60 65 70

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tgt gga gac tac gct gtg tgt gca aac acc aga atg aat gat gag gaa 413
Cys Gly Asp Tyr Ala Val Cys Ala Asn Thr Arg Met Asn Asp Glu Glu
    75                      80                      85

aga gca tta cga tgc ggc tgc ata tta ggg tac acc gta atg aat gag 461
Arg Ala Leu Arg Cys Gly Cys Ile Leu Gly Tyr Thr Val Met Asn Glu
    90                      95                      100                      105

gtg tgt act cca aat aaa tgt aac ggc gtt ttg tgt gga aag gga aag 509
Val Cys Thr Pro Asn Lys Cys Asn Gly Val Leu Cys Gly Lys Gly Lys
                110                      115                      120

tgc atc tta gat ccc gct aat gtg aac agc acc atg tgc tct tgt aat 557
Cys Ile Leu Asp Pro Ala Asn Val Asn Ser Thr Met Cys Ser Cys Asn
                125                      130                      135

ata gga acc aca ttg gat gaa tct aaa aaa tgt gga aag cca gga aaa 605
Ile Gly Thr Thr Leu Asp Glu Ser Lys Lys Cys Gly Lys Pro Gly Lys
                140                      145                      150

act gaa tgc acg ttg aag tgt aag gca aac gaa gaa tgt aaa gag act 653
Thr Glu Cys Thr Leu Lys Cys Lys Ala Asn Glu Glu Cys Lys Glu Thr
    155                      160                      165

cag aat tat tac aag tgc gtt gcg aag gga agc ggc gga gaa ggc agc 701
Gln Asn Tyr Tyr Lys Cys Val Ala Lys Gly Ser Gly Gly Glu Gly Ser
    170                      175                      180                      185

ggt gga gaa ggc agc ggc gga gag ggc agc ggc gga gag ggc agc ggc 749
Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly
                190                      195                      200

gga gag ggc agc ggt gga gac aca gga gca gct tac agt ctc atg aac 797
Gly Glu Gly Ser Gly Gly Asp Thr Gly Ala Ala Tyr Ser Leu Met Asn
                205                      210                      215

gga tct gca gta atc agc ata cta ctt gta ttc gcc ttc ttc atg atg 845
Gly Ser Ala Val Ile Ser Ile Leu Leu Val Phe Ala Phe Phe Met Met
    220                      225                      230

tca tta gtg tagacgattc tacacacaca cacaacata cacaagggga 894
Ser Leu Val
    235

gaagcgtctc acagagtcag ttcaagtcac acgcacaaaa aaggaaagta catccagctg 954

gtgaaagagc atttatgtgt gcagttatcc ttgggagaag caccctccac ccagttgcgt 1014

tgctgttacc ttaaaactta gtggcaccca tatcgaattt gactttgctc gc 1066

<210> 2
<211> 236
<212> PRT
<213> Plasmodium vivax

<400> 2
Met Asn Thr Tyr His Ser Leu Leu Phe Leu Leu Ala Ile Val Leu Thr
    1                      5                      10                      15

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Val Lys His Thr Phe Ala Lys Val Thr Ala Glu Thr Gln Cys Lys Asn
 20 25 30
 Gly Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp
 35 40 45
 Gly Phe Val Met Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys
 50 55 60
 Thr Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys
 65 70 75 80
 Ala Asn Thr Arg Met Asn Asp Glu Glu Arg Ala Leu Arg Cys Gly Cys
 85 90 95
 Ile Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Asn Lys Cys
 100 105 110
 Asn Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn
 115 120 125
 Val Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Thr Thr Leu Asp Glu
 130 135 140
 Ser Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys
 145 150 155 160
 Lys Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val
 165 170 175
 Ala Lys Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 180 185 190
 Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp
 195 200 205
 Thr Gly Ala Ala Tyr Ser Leu Met Asn Gly Ser Ala Val Ile Ser Ile
 210 215 220
 Leu Leu Val Phe Ala Phe Phe Met Met Ser Leu Val
 225 230 235

<210> 3
 <211> 995
 <212> DNA
 <213> Plasmodium vivax

<220>
 <221> CDS
 <222> (255)..(914)
 <223> Pvs25

<400> 3
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 tttcgattgt ttgcttgttt gcttttttgc ttattcgccc gtttttccgc ttgcccgttc 120
 gcccgtcca caacgcgccg ctgcaaaggt tgcccaccac cgaccacaaa aacttattca 180
 ccaccatccg agcggaaagg aacgccgccc actgtgctgc ctacctcccc gaataacaac 240

<210> 4
 <211> 219
 <212> PRT
 <213> Plasmodium vivax

<400> 4
 Met Asn Ser Tyr Tyr Ser Leu Phe Val Phe Phe Leu Val Gln Ile Ala
 1 5 10 15
 Leu Lys Tyr Ser Lys Ala Ala Val Thr Val Asp Thr Ile Cys Lys Asn
 20 25 30
 Gly Gln Leu Val Gln Met Ser Asn His Phe Lys Cys Met Cys Asn Glu
 35 40 45
 Gly Leu Val His Leu Ser Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys
 50 55 60
 Lys Lys Glu Thr Leu Gly Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile
 65 70 75 80
 Glu Asn Pro Asp Pro Ala Gln Val Asn Met Tyr Lys Cys Gly Cys Ile
 85 90 95
 Glu Gly Tyr Thr Leu Lys Glu Asp Thr Cys Val Leu Asp Val Cys Gln
 100 105 110
 Tyr Lys Asn Cys Gly Glu Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser
 115 120 125
 Glu Ile Gln Ser Ala Gly Cys Ser Cys Ala Ile Gly Lys Val Pro Asn
 130 135 140
 Pro Glu Asp Glu Lys Lys Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln
 145 150 155 160
 Leu Lys Cys Asn Thr Asp Asn Glu Val Cys Lys Asn Val Glu Gly Val
 165 170 175
 Tyr Lys Cys Gln Cys Met Glu Gly Phe Thr Phe Asp Lys Glu Lys Asn
 180 185 190
 Val Cys Leu Ser Tyr Ser Val Phe Asn Ile Leu Asn Tyr Ser Leu Phe
 195 200 205
 Phe Ile Ile Leu Leu Val Leu Ser Tyr Val Ile
 210 215

<210> 5
 <211> 377
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs25-Pvs28
 fusion protein

<400> 5
 Ala Val Thr Val Asp Thr Ile Cys Lys Asn Gly Gln Leu Val Gln Met
 1 5 10 15

Ser Asn His Phe Lys Cys Met Cys Asn Glu Gly Leu Val His Leu Ser
 20 25 30

Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys Lys Lys Glu Thr Leu Gly
 35 40 45

Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile Glu Asn Pro Asp Pro Ala
 50 55 60

Gln Val Asn Met Tyr Lys Cys Gly Cys Ile Glu Gly Tyr Thr Leu Lys
 65 70 75 80

Glu Asp Thr Cys Val Leu Asp Val Cys Gln Tyr Lys Asn Cys Gly Glu
 85 90 95

Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser Glu Ile Gln Ser Ala Gly
 100 105 110

Cys Ser Cys Ala Ile Gly Lys Val Pro Asn Pro Glu Asp Glu Lys Lys
 115 120 125

Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln Leu Lys Cys Asn Thr Asp
 130 135 140

Asn Glu Val Cys Lys Asn Val Glu Gly Val Tyr Lys Cys Gln Cys Met
 145 150 155 160

Glu Gly Phe Thr Phe Asp Lys Glu Lys Asn Val Cys Leu Ser Gly Gly
 165 170 175

Gly Pro Gly Gly Gly Ala Lys Val Thr Ala Glu Thr Gln Cys Lys Asn
 180 185 190

Gly Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp
 195 200 205

Gly Phe Val Met Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys
 210 215 220

Thr Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys
 225 230 235 240

Ala Asn Thr Arg Met Asn Asp Glu Glu Arg Ala Leu Arg Cys Gly Cys
 245 250 255

Ile Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Asn Lys Cys
 260 265 270

Asn Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn
 275 280 285

Val Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Thr Thr Leu Asp Glu
 290 295 300

Ser Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys
 305 310 315 320

Lys Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val
 325 330 335

Ala Lys Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 340 345 350

Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp
 355 360 365

Thr Gly Ala Ala Tyr Ser Leu Met Asn
 370 375

<210> 6
 <211> 21
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:sense primer

<400> 6
 ggwtttytrr ytcaratgag t 21

<210> 7
 <211> 17
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:vector-specific
 M13 universal primer

<400> 7
 gtaaaacgac ggccagt 17

<210> 8
 <211> 24
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:internal
 degenerate sense primer

<400> 8
 tcaratgagt rrycatttdg aatg 24

<210> 9
 <211> 25
 <212> DNA
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:PCR-sense
 splinkerette #1 primer

<400> 9
 cgaatcgtaa ccgttcgtac gagaa 25

<210> 10
 <211> 20
 <212> DNA
 <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:antisense Pvs25
 specific primer

<400> 10
 ggacaagcag gatgataaaag

20

<210> 11
 <211> 25
 <212> DNA
 <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:nested PCR
 sense splinkerette #2 internal primer

<400> 11
 tcgtaccaga atcgctgtcc tctcc

25

<210> 12
 <211> 21
 <212> DNA
 <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:anti-sense
 Pvs25 specific internal primer

<400> 12
 agcacacaag tgtcttcctt c

21

<210> 13
 <211> 18
 <212> DNA
 <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:gene specific
 PCR sense primer

<400> 13
 actttcgttt cacagcac

18

<210> 14
 <211> 20
 <212> DNA
 <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:gene specific
 PCR anti-sense primer

<400> 14
aaaggacaag caggatgata

20

<210> 15
<211> 7
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:flexible linker

<400> 15
Gly Gly Gly Pro Gly Gly Gly
1 5

<210> 16
<211> 186
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:Pvs25 fusion
protein

<400> 16
Glu Ala Glu Ala Ser Ala Val Thr Val Asp Thr Ile Cys Lys Asn Gly
1 5 10 15
Gln Leu Val Gln Met Ser Asn His Phe Lys Cys Met Cys Asn Glu Gly
20 25 30
Leu Val His Leu Ser Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys Lys
35 40 45
Lys Glu Thr Leu Gly Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile Glu
50 55 60
Asn Pro Asp Pro Ala Gln Val Asn Met Tyr Lys Cys Gly Cys Ile Glu
65 70 75 80
Gly Tyr Thr Leu Lys Glu Asp Thr Cys Val Leu Asp Val Cys Gln Tyr
85 90 95
Lys Asn Cys Gly Glu Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser Glu
100 105 110
Ile Gln Ser Ala Gly Cys Ser Cys Ala Ile Gly Lys Val Pro Glu Pro
115 120 125
Glu Asp Glu Lys Lys Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln Leu
130 135 140
Lys Cys Asn Thr Asp Asn Glu Val Cys Lys Asn Val Glu Gly Val Tyr
145 150 155 160
Lys Cys Gln Cys Met Glu Gly Phe Thr Phe Cys Lys Glu Lys Asn Val
165 170 175

Cys Leu Gly Pro His His His His His His
 180 185

<210> 17
 <211> 205
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs28 fusion
 protein

<400> 17
 Glu Ala Glu Ala Ser Lys Val Thr Ala Glu Thr Gln Cys Lys Asn Gly
 1 5 10 15
 Tyr Val Val Gln Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp Gly
 20 25 30
 Phe Val Leu Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr
 35 40 45
 Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala
 50 55 60
 Asn Thr Arg Met Asn Asn Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile
 65 70 75 80
 Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Tyr Lys Cys Asn
 85 90 95
 Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val
 100 105 110
 Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Ser Thr Leu Asp Glu Ser
 115 120 125
 Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys
 130 135 140
 Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala
 145 150 155 160
 Lys Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu
 165 170 175
 Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp Thr
 180 185 190
 Gly Ala Ala Tyr Ser Gly Pro His His His His His His
 195 200 205

<210> 18
 <211> 205
 <212> PRT
 <213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:Pvs28Q130
fusion protein

<400> 18

Glu	Ala	Glu	Ala	Ser	Lys	Val	Thr	Ala	Glu	Thr	Gln	Cys	Lys	Asn	Gly	1	5	10	15
Tyr	Val	Val	Gln	Met	Ser	Asn	His	Phe	Glu	Cys	Lys	Cys	Asn	Asp	Gly	20	25	30	
Phe	Val	Leu	Ala	Asn	Glu	Asn	Thr	Cys	Glu	Glu	Lys	Arg	Asp	Cys	Thr	35	40	45	
Asn	Pro	Gln	Asn	Val	Asn	Lys	Asn	Cys	Gly	Asp	Tyr	Ala	Val	Cys	Ala	50	55	60	
Asn	Thr	Arg	Met	Asn	Asn	Glu	Glu	Arg	Ala	Leu	Arg	Cys	Gly	Cys	Ile	65	70	75	80
Leu	Gly	Tyr	Thr	Val	Met	Asn	Glu	Val	Cys	Thr	Pro	Tyr	Lys	Cys	Asn	85	90	95	
Gly	Val	Leu	Cys	Gly	Lys	Gly	Lys	Cys	Ile	Leu	Asp	Pro	Ala	Asn	Val	100	105	110	
Gln	Ser	Thr	Met	Cys	Ser	Cys	Asn	Ile	Gly	Ser	Thr	Leu	Asp	Glu	Ser	115	120	125	
Lys	Lys	Cys	Gly	Lys	Pro	Gly	Lys	Thr	Glu	Cys	Thr	Leu	Lys	Cys	Lys	130	135	140	
Ala	Asn	Glu	Glu	Cys	Lys	Glu	Thr	Gln	Asn	Tyr	Tyr	Lys	Cys	Val	Ala	145	150	155	160
Lys	Gly	Ser	Gly	Gly	Glu	Gly	Ser	Gly	Gly	Glu	Gly	Ser	Gly	Gly	Glu	165	170	175	
Gly	Ser	Gly	Gly	Glu	Gly	Ser	Gly	Gly	Glu	Gly	Ser	Gly	Gly	Asp	Thr	180	185	190	
Gly	Ala	Ala	Tyr	Ser	Gly	Pro	His	His	His	His	His	His	His			195	200	205	

<210> 19

<211> 169

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:Pvs28NCR fusion
protein

<400> 19

Glu	Ala	Glu	Ala	Ser	Lys	Val	Thr	Ala	Glu	Thr	Gln	Cys	Lys	Asn	Gly	1	5	10	15
Tyr	Val	Val	Gln	Met	Ser	Asn	His	Phe	Glu	Cys	Lys	Cys	Asn	Asp	Gly	20	25	30	

Phe Val Leu Ala Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr
 35 40 45
 Asn Pro Gln Asn Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala
 50 55 60
 Asn Thr Arg Met Asn Asn Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile
 65 70 75 80
 Leu Gly Tyr Thr Val Met Asn Glu Val Cys Thr Pro Tyr Lys Cys Asn
 85 90 95
 Gly Val Leu Cys Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val
 100 105 110
 Asn Ser Thr Met Cys Ser Cys Asn Ile Gly Ser Thr Leu Asp Glu Ser
 115 120 125
 Lys Lys Cys Gly Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys
 130 135 140
 Ala Asn Glu Glu Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala
 145 150 155 160
 Lys Gly Pro His His His His His His
 165

<210> 20

<211> 174

<212> PRT

<213> Artificial Sequence

<220>

<223> Description of Artificial Sequence:Pvs25 domain of
Pvs25-Pvs28 fusion protein

<400> 20

Ala Val Thr Val Asp Thr Ile Cys Lys Asn Gly Gln Leu Val Gln Met
 1 5 10 15
 Ser Asn His Phe Lys Cys Met Cys Asn Glu Gly Leu Val His Leu Ser
 20 25 30
 Glu Asn Thr Cys Glu Glu Lys Asn Glu Cys Lys Lys Glu Thr Leu Gly
 35 40 45
 Lys Ala Cys Gly Glu Phe Gly Gln Cys Ile Glu Asn Pro Asp Pro Ala
 50 55 60
 Gln Val Asn Met Tyr Lys Cys Gly Cys Ile Glu Gly Tyr Thr Leu Lys
 65 70 75 80
 Glu Asp Thr Cys Val Leu Asp Val Cys Gln Tyr Lys Asn Cys Gly Glu
 85 90 95
 Ser Gly Glu Cys Ile Val Glu Tyr Leu Ser Glu Ile Gln Ser Ala Gly
 100 105 110
 Cys Ser Cys Ala Ile Gly Lys Val Pro Asn Pro Glu Asp Glu Lys Lys
 115 120 125

Cys Thr Lys Thr Gly Glu Thr Ala Cys Gln Leu Lys Cys Asn Thr Asp
 130 135 140

Asn Glu Val Cys Lys Asn Val Glu Gly Val Tyr Lys Cys Gln Cys Met
 145 150 155 160

Glu Gly Phe Thr Phe Asp Lys Glu Lys Asn Val Cys Leu Ser
 165 170

<210> 21
 <211> 196
 <212> PRT
 <213> Artificial Sequence

<220>
 <223> Description of Artificial Sequence:Pvs28 domain of
 Pvs25-Pvs28 fusion protein

<400> 21
 Ala Lys Val Thr Ala Glu Thr Gln Cys Lys Asn Gly Tyr Val Val Gln
 1 5 10 15
 Met Ser Asn His Phe Glu Cys Lys Cys Asn Asp Gly Phe Val Met Ala
 20 25 30
 Asn Glu Asn Thr Cys Glu Glu Lys Arg Asp Cys Thr Asn Pro Gln Asn
 35 40 45
 Val Asn Lys Asn Cys Gly Asp Tyr Ala Val Cys Ala Asn Thr Arg Met
 50 55 60
 Asn Asp Glu Glu Arg Ala Leu Arg Cys Gly Cys Ile Leu Gly Tyr Thr
 65 70 75 80
 Val Met Asn Glu Val Cys Thr Pro Asn Lys Cys Asn Gly Val Leu Cys
 85 90 95
 Gly Lys Gly Lys Cys Ile Leu Asp Pro Ala Asn Val Asn Ser Thr Met
 100 105 110
 Cys Ser Cys Asn Ile Gly Thr Thr Leu Asp Glu Ser Lys Lys Cys Gly
 115 120 125
 Lys Pro Gly Lys Thr Glu Cys Thr Leu Lys Cys Lys Ala Asn Glu Glu
 130 135 140
 Cys Lys Glu Thr Gln Asn Tyr Tyr Lys Cys Val Ala Lys Gly Ser Gly
 145 150 155 160
 Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly
 165 170 175
 Glu Gly Ser Gly Gly Glu Gly Ser Gly Gly Asp Thr Gly Ala Ala Tyr
 180 185 190
 Ser Leu Met Asn
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<210> 22
<211> 4
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:sequence added
to enhance cleavage of alpha factor leader

<400> 22
Glu Ala Glu Ala
1

<210> 23
<211> 9
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:sequence added
to enhance cleavage of alpha factor leader

<400> 23
Glu Ala Glu Ala Glu Ala Glu Ala Lys
1 5

<210> 24
<211> 6
<212> PRT
<213> Artificial Sequence

<220>
<223> Description of Artificial Sequence:polyhistidine
tag

<400> 24
His His His His His His
1 5